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ABSTRACT

A survey undertaken in June 1980 sought to determine the types of computers used for instructional purposes in the Ontario schools. A brief questionnaire was sent to elementary and secondary schools, both public and private. The study revealed that the present use of computers in instruction is confined almost exclusively to secondary schools. Seventy-four percent of the responding secondary schools reported using computers for instructional purposes, though the percentage varies widely by region. Use of computers is highest in the most populous regions and is also related to school enrollment. The elementary schools reported using only micro computers, but at the secondary level all types of computers proved popular. A primary recommendation of the study is the establishment of more uniform access to computers in secondary schools. Decisions about the type of computer provided must be based upon individual schools' needs and resources. Appended are a sample questionnaire and tables presenting survey results. (Author/WD)

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USE OF COMPUTERS FOR INSTRUCTIONAL PURPOSES IN ONTARIO SCHOOLS

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USE OF COMPUTERS FOR INSTRUCTIONAL PURPOSES IN ONTARIO SCHOOLS *

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This report provides an overview of the results of a survey undertaken in June 1980 to determine the types of computers used for instructional purposes in Ontario's schools. A brief questionnaire (Figure 1) was sent

Insert Figure 1 about here

to every secondary school and a sample of public and separate schools. Data on the use of computers, types of computers used, modes of access to these computers, and years in which use of different types of computers commenced are presented. Where appropriate, analyses by geographic region, school level and school size are reported, and projections are made as to the future levels of usage of computers in Ontario schools.

Sample.

For the purposes of this study, all Ontario schools were classified as elementary or secondary schools, with separate schools being placed in one of these two categories depending on the grades enrolled. Hence, the elementary schools include schools enrolling students in grades K through 8 or 9, or some combination of these grades, while secondary schools are schools enrolling grades 9 or 10 through 13, or some combination of these grades. Separate schools which, according to the Ontario Directory of Education 1979/1980, enrolled only grades 7 through 10 or 9 and 10 were classed as secondary schools, since these schools typically offer grades 11 to 13 under the auspices of private Roman Catholic school boards. This mode of classification is more useful for purposes of analysis than the usual elementary, separate, and secondary school categorization since it is based on the grades taught in a school rather than the legal designation of the school. In addition, the presence or absence in each school of junior (4-6) and senior (7-8) elementary grades was recorded in order to facilitate more detailed analyses of the data according to the level of program offered.

In the survey, a letter and stamped postcard-sized questionnaire were mailed to all 684 secondary schools in Ontario and to 381 elementary schools, the latter representing a systematic sample of 1 in 10 schools, although in

* This research funded by a grant from OISE. The authors wish to thank Mrs. Pearl Kaplan for her assistance on the conduct of this survey.

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Metro Toronto a phone survey of elementary schools in the sample was conducted in order to reduce mailing costs. A similar phone survey of secondary schools did not prove feasible since it was difficult to locate the administrator or teacher who knew the answers to the questions being asked.

In all, responses were received from 479 secondary schools (70%) and 255 elementary schools (67%), for an overall response rate of 69%. The sample of responding schools was examined for evidence of bias related to their geographical location or to their size (Table 1).

Insert Table 1 about here

Rates of return for secondary schools showed little variation from region to region, ranging from 64 percent in Northwestern Ontario to 74 percent in Eastern Ontario. Regional variation in return rates was greater for elementary schools, ranging from 52 percent in Eastern Ontario to 80 percent in Northwestern Ontario. Given that there were fewer elementary than secondary schools in the regional subsamples, such wider variation in return rates was to be expected. In any case, there does not appear to be a trend in values of return rates that would suggest a systematic bias in the sample. This point is illustrated by the reversal of the relative positions of Northwestern and Eastern Ontario in terms of their return rates at the elementary and secondary levels.

There does appear to be a slight bias toward larger schools in the sample of schools that responded. At the secondary level, the average enrolment of responding schools was 947, or 2.5 percent greater than the provincial-wide average of 923. The bias was somewhat stronger for elementary schools: responding schools averaged 354 pupils, 26 or 7.9 percent more than the province-wide average. In our opinion, only the latter bias is sufficiently large to be of practical importance. Hence, in interpreting the data for elementary schools, one should bear in mind that the findings apply to schools that are slightly larger than average.

The relationship between average school enrolment and geographical region apparent in Table 1 should be noted. Midnorthern Ontario, incorporating Sudbury, Manitoulin and Algoma, and Northwestern Ontario, incorporating Thunder Bay, Rainy River and Kenora, have schools with average enrolments that are substantially below those elsewhere in the province. Enrolments in schools in

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Northeastern Ontario, representing Muskoka, Parry Sound, Nipissing, Timiskaming and Cochrane, are also somewhat smaller than average.

Use of Computers.

The use of computers in Ontario schools is confined almost exclusively to secondary schools at the present time, as is evident in Table 2. Seventy-four

Insert Table 2 about here

percent of the responding secondary schools reported using computers for instructional purposes, whereas only 5.5 percent of all responding elementary schools did so. Applied to the total number of schools in the province at each level, these rates of usage imply approximately 504 of 684 secondary schools and 210 of about 3,800 elementary schools use computers for instructional purposes.

The percentages of schools using computers for instructional purposes varies widely by region. At the elementary level, all such schools appear to be located in either Central or Western Ontario, though of course the sampling errors associated with the regional subsamples are quite large. The sample no doubt missed a few elementary schools in each region that use computers; however, the overall pattern of usage is clear.

Use of computers in secondary schools is highest in the most populous regions; Central, Western and Eastern Ontario have the highest rates of usage averaging 77 percent; those in Midnorthern and Northwestern Ontario are somewhat lower, averaging 66 percent; that in Northwestern Ontario is lowest at only 44 percent.

Use of computers for instructional purposes is also related to school enrolment (Table 3).

Insert Table 3 about here

At the elementary level this relationship is irregular; they are used in two very small schools which, on inspection, proved to be "alternative" schools in Metro Toronto. Otherwise, they are concentrated in schools with over 250 students. At the secondary level, the relationship is far more systematic, with percentages of schools using computers increasing from 25 percent of those with fewer than 101 students, to about 50 percent of those enrolling between 100 and 751 students, 80 percent of those enrolling between 750 and 1,251 to 1,500 students, and essentially

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100 percent of those with more than 1,500 students. Clearly, small enrolments tend to be a barrier to the use of computers, but since there are secondary schools of all sizes that do use computers, apparently it is a barrier that can be overcome.

It appeared from Tables 1 and 3 that the small size of the average secondary school in Northwestern Ontario might explain the low rate of computer usage (44 percent) in that region. To test this hypothesis, Table 4 was constructed. In it, rates of computer usage for schools of different sizes in the Northwestern region are compared with provincial average rates of usage for schools of different sizes. It appears that the presence of small schools does not explain the low

Insert Table 4 about here

percentage of schools using computers for instructional purposes in the Northeastern Region. Only 29 percent of the schools in the 251 to 500 enrolment category, and only 60% of the schools in the 1,001 to 1,250 enrolment category, use computers, as oppposed to the provincial averages of 52 percent and 84 percent respectively. Admittedly, the small numbers of schools and students involved in these schools is not apparent in the percentages; there are many more students without access to computers in the small secondary schools of Central Ontario.

Types of Computers in Use.

In the survey, respondents were asked to indicate the use of three types of computers, categorized according to size: micro, mini, and macro. It was assumed that micro and mini computers could be located in the school, or that they could be located elsewhere with access supplied via terminals, courier services, remote job entry (RJE) card readers, or student visits to the site housing the computers. For macro computers, it was assumed that remote access would be necessary.

For the 14 elementary schools using computers, only use of micro computers was reported. Given the small number of schools involved and the single type of computer in use, no further analysis of these data were carried out, though future adoption of computers in elementary schools is commented upon later.

For secondary schools, all types of computers proved popular, as indicated in Table 5 in which the type of computers used is crosstabulated by region. In each region, different patterns apply. In densely populated Central Ontario, micro-computers, macro-computers, and on-site mini-computers are all popular. Between the latter two options, there appears to be a preference for the use of macro-computers, though in notes, some respondents noted that they were shifting from courier access to a remote macro-computer to an on-site mini. The pattern in

Eastern Ontario is similar to that in Central Ontario, though on-site mini's appear somewhat more popular than macro-computers. Western Ontario provides another variation to this pattern, with approximately a quarter of the schools reporting remote access to mini-computers.

Strikingly different patterns apply to the three Northern Regions. In these, micro-computers carry the major share of the burden. No other type was reported in Northwestern Ontario; some use of on-site minis was reported in the other two Northern regions; only in the Midnorthern Region did a significant percentage report use of macro-computers.

Given the frequency of use reported, it is clear that many schools use more than one type of computer; this topic is dealt with later.

The relationship between a school's enrolment and the type of computers used is reported in Table 6. Although micro-computers seem popular in schools

Insert Table 6 about here

of all sizes, they seem most popular in schools with enrolments between 750 and 2,000, and least popular in those with fewer than 100 or more than 2,000 students. The use of mini-computers - both on-site and remote - tends to increase with school size. A similar relationship holds for macro-computers. One anomally is of particular note. In the 1,751 to 2,000 student category, only 29 percent of the schools reported using in-house mini-computers, while 64 percent reported using macro-computers. In the over 2,000 category, this relationship was reversed, with 63 percent reporting in-house mini's and only 38 percent reporting the use of macro's. Clearly, those in large schools prefer minis over macro or micro-computers, with minis in effect substituting for both other types of computers.

Models of Computers.

In addition to indicating the types of computers used for instructional purposes, respondents were asked to indicate the particular models in use, and the numbers of these models.

Table 7 reports the numbers of different models of micro-computers presently used in Ontario's secondary schools. PET micro-computers are clearly the most

Insert Table 7 about here

popular, and are found in 28 percent of the responding schools. While 10 percent of all schools reported only one PET, 6 percent reported three and 3 percent reported six, with lower percentages reporting two, four, and seven or more. The peaks at multiples of three reflects the "three for the price of two" offer available to schools from Commodore, PET's manufacturer.

TRS-80's, sold by Radio Shack,are the next most popular micro; they are found in 11 percent of all schools. The largest percentage of schools have just one. Smaller percentages report two or more. Also present, though quite rare, in Ontario's schools are APPLE's, Ohio Scientific micros and SOL's. A significant number of other micros were mentioned. In some cases, respondents noted that they had a micro in the school, but did not indicate the model. These were classed as "others," as well.

Table 8, which summarizes the data for in-school mini-computers, shows that PDP-11's and IBM 1130's are the two most popular minis, followed by WANG's and PDP-8's, though there appears to be no overall favorite. Schools having remote access to minis reported using these same models (Table 9) though IBM 1130's were most commonly used in this manner. Access was typically provided by a courier service (Table 10).

Insert Tables 8, 9, 10 about here

IBM 370's were the most commonly used macro-computers, with 15 percent of all responding secondary schools reporting their use. IBM 360's were next most popular (Table 11). Again, courier services were the most common mode of access (26 precent of all schools), though the use of terminals or RJE was quite common (Table 12).

Insert Tables 11 and 12 about here

Combinations of Computer Types.

As noted earlier, many schools have access to more than one type of computer. Table 13 reports the various combinations by region of the province. Evident in this table is the dependence of northern Ontario secondary schools on micro-computers as their only computers. Rarely do schools there have access to more than one type of computer, an exception being two schools in the Midnorthern Region with access to all three types. In other regions, the most popular combination is that of a micro and access to a macro-computer.

Insert Table 13 about here

The relationship between the combinations of computers used and school enrolment is reported in Table 14. Sole dependence on micro-computers tends to decline as school size increases: 31 percent of the schools with fewer than 500 students depend on micros, whereas only 11 percent of those with over 1,500 do so. In contrast, the percentage with sole dependence on minis or macros increases with size, as does the percentage with various combinations. For example, access to a micro and macro-computer increases from 6 percent of the schools with enrolment under 500 to 20 percent of those with over 1,500 students. Both Table 13 and 14 suppport the inference made earlier that an in-house mini, or an in-house micro and remote access to a macro-computer, are the two most popular choices among large secondary schools. Schools appear more willing to depend on an in-house mini than on either micros alone or remote access to a macro-computer.

Insert Table 14 about here

Combinations of different models, as opposed to types, of computers were reported only for micro-computers. Even then, however, combinations were rare, as can be seen in Table 15. Two percent of all schools responding reported having both a PET and a TRS-80; one percent a PET and an APPLE, and 0.2 percent a TRS-80 and an APPLE. None reported all three of the leading models.

Insert Table 15 about here

Year of Adoption.

As a final question, respondents were asked the year in which each type (not model) of computer was used. These data are useful for several purposes. First, they indicate when a trend to adopt each type of computer commenced; second, they show how rapidly adoption is occuring; and finally, they make it possible to make projections as to the future pattern of adoption.

In Table 16 is reported the number of computers of each type and model adopted in each of the years from 1965 to 1980. The data are in fact complete only through the 1979-80 academic year designated by 1979; beside 1980 are indicated anticipated adoptions for the 1980-81 school year. Another caveat is also necessary. Since only the year a given type (micro, mini, or macro) of computer was first used was requested, the reporting of that year as the year of adoption for a particular model mentioned represents an inference on our part that a respondent's school has

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not changed models. The pre-1970 adoptions of IBM 370's we report are probably due to invalid references of this type. In other cases, however, there is no apparent problem and, since IBM 360's and 370's are pooled for analytic purpose, even this difficulty can be overlooked.

Insert Table 16 about here

It is clear from Table 16 that the use of computers for instructional purposes has been greatly facilitated by the development of each new type and each new model of computer. First, only remote access to larger IBM machines was available, followed by remote access to IBM 1130's. The first wave of adoption of macro-computers began in 1965, and was complete by 1976, after which a new wave appears to have commenced. By 1976. the life cycle of IBM 1130's was over, helped along by the rapid introduction of WANG's. Even then, just as the adoption of WANG's was peaking, PDP-11's were becoming available; it appears that their popularity may still be growing. Only in 1977 did micro-computers come on the scene. Though PET's appear first, in 1978 it appears that TRS-80's were equally popular. In 1979, however, PET's clearly moved ahead of the field.

This heuristic discussion trends can be made more concrete by using a logistic curve to "model" the data. This type of curve is analogous to the S-shaped demand curve familiar to economists, or to the cumulative amounts of a compound that are formed as an autocatalytic chemical reaction proceeds from start to finish. The model requires three parameters: P, the rate of adoption; S_1, the number of adoptions in the first year of the cycle; and N, the total number of adopters. A fourth "parameter," N_o, can be derived from the other three; it represents the "seed" that helps to catalyze the process. Two other useful statistics can be derived: S_m, the peak number of adoptions in a single year, and Y_m, the year in which this peak occurs.

The logistic model outlined above was used to model the life cycles of the various types and models of computers used in Ontario's schools. In some cases, life cycles were already complete; in others, they were just beginning. In the latter cases, projections of future adoptions were made.

Table 17 reports the life cycle analysis for macro-computers. As noted earlier, inspection of the data suggested that the initial cycle of adoption of macro-computers commenced in 1965 and ended in 1976. The model smooths out the irregu-

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larities found in the actual data, and provides the estimates of parameters P, S_1, and N reported in Table 18. The standard errors of the estimates appear satisfactory, given the values of the parameters estimated. Of particular value is the estimate of P, which can be used, in conjunction with the numbers of adoption of macro-computers in 1977, 1978, and 1979, to project the future number of adoptions.

To make projections of adoptions, it is generally necessary to fix at least one of the three parameters; otherwise, an infinite number of adoptions is usually projected. Usually, one either selects a reasonable rate constant, P, or a reasonable number of total adoption, N. What one considers reasonable is generally based on previous experience in similar situation. In this case, fixing P = .73, the rate constant estimated from the first cycle of adoptions for macro-computers, appears reasonable.

The projected number of future adoptions of macro-computers (i.e., decisions to use macro-computers for instructional purposes via remote linkages) are reported by year in Table 17. The model indicates that adoptions probably peaked in 1979, and will taper off through 1985. The total number of additional adoptions is about 87 with a standard error of 8.6. (see Table 18). Adding these 87 to the 61 schools that had begun using macro-computers before 1977 yields a total of 149 schools with access to macros, or 31 percent of all responding schools.

Insert Tables 17 and 18 about here

Tables 19 and 20 report a similar type of analysis of the life cycle of mini-computers. For these, the years of adoption for different models appeared to correspond closely to the years in which mini-computers were first used, so that analysis by model was possible. In all, data on four life cycles were treated; those for IBM 1130's, those for Wang's, those for PDP-11's, and those for all minis. For the first two, it appears that the adoption life cycles are complete.

Insert Tables 19 and 20 about here

For PDP-11's, it was necessary to fix one of the parameters; we chose to fix N at 60, since this seemed reasonable in view of the fact it appears PDP-11's are being adopted in larger numbers than were Wangs. Also, using N = 60 yielded a rate constant around 1, higher than that for Wang's, but not unusually high for a popular innovation.

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Several points regarding the estimates and projections related to the life cycles of mini-computers bear comment. First, each model of machine appears to have been adopted at a higher rate than preceding models: P = 0.33 for IBM 1130, 0.87 for Wangs, and an estimated 1.09 for PDP-11's. Second, the rate constant for the adoption of all minis is low at 0.23; that is, it conceals the high rate of adoption for particular models. Third, the projected number of total adoptions, at 197, represents 41 percent of the 479 schools that responded, though the rather large standard error of 68 suggests the actual figure could be considerably higher or lower. Fourth, the fact it was not necessary to fix a parameter to estimate future overall adoptions implies that, barring a major change in the environment, the course of adoption is well set. Fifth, the fact that the adoption of PDP-11's may be peaking in 1980 whereas the projection of overall adoptions remains high until the late 1980's, implies the time may be ripe for a new model to steal PDP's thunder as PDP did to Wang's. Finally, given that minis and macros tend to be complementary, and not both used by the same school, it would appear that the eventual rate of penetration for minis and macros would be about the sum of their individual rates of penetration, 31 percent and 41 percent, or 72 percent.

The most striking projections, however, are those developed for micro-computers (Table 21). So little data is available, it is necessary to fix one parameter. Given the high overall rate of penetration (29 percent) after only three years, it only seemed reasonable to project 100% adoption, eventually. Though this assumption might at first appear extreme, and produces an extra-ordinarily high estimated rate of adoption (2.19), the small standard errors for this rate and the close fit between actual and estimated numbers of adoptions for 1977, 1978, and 1979, confirm its acceptability. Given this assumption, then, the model indicates all Ontario secondary schools will have at least one micro-computer by 1983.

Insert Table 21 about here

PET, of course, appears destined to have the lion's share of the market. Assuming PET's are purchased by 80 percent of all schools (a proportion similar to that among schools that already have micros), yields the life cycle of adoptions projected in Table 21.

The question regarding micros that arises, given these projections, is not <u>if</u> secondary schools will have them, but how many they will have.

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In theory, it would also be possible to project the number of elementary schools that will adopt the use of micro-computers for instructional purposes for the coming decade. In fact, the scarcity of data - 7 indicated adoption in 1979 and 4 in 1980, with 3 not indicating the first year of usage - makes any reasonable projection impossible. Finally, on the chance that the 14 elementary schools reporting use of computers were senior public schools, the grade levels in these schools were inspected. No such relationship appears to exist.

Discussions and Recommendations.

The results of this survey clearly indicate that secondary schools are deeply involved in computing, and are rapidly adopting for their use newer, smaller computers. It is no longer reasonable to consider access to computers by students as frill to be found only in large schools; access to them is, in most schools, one of the routine opportunities provided.

The situation in elementary schools is not as clear. At that level, use of computers is at an early, experimental stage. While for secondary schools, one must be concerned about those schools in which students do not have access to computers, this is not yet the case for elementary schools.

The primary recommendations that might be based on this study relate to the establishment of a more uniform level of access to computing in secondary schools. The particular targets identified in the survey as being less likely to provide access at the current time are smaller secondary schools, enrolling fewer than 1,000 students, and schools in the North, especially the Northeastern Region.

A second, related issue, is the type of computer to which access is provided. A particularly crucial decision appears to be whether a secondary school should be provided its own mini-computer, or a combination of in-house micro-computers and access to macro-computers. There may not - indeed probably is not - a single answer to this question since the availability of a macro-computer, the type of access (courier, terminal or RJE) to it, and the school program all could affect the choice.

The need to tailor the answer to individual school or board environments means that any provincial action to encourage more widespread access to computers should allow flexibility at the local level. A favored approach, recently used by the province to encourage French and Heritage Language programs, is a form of stimulation grant. However, in order not to bias local decisions, such fiscal measures should treat all types of computers equally. If micros were treated as supplies, while minis were treated as capital items, different rate of grants might apply that could distort the decision-making process in boards by making one form of computing less expensive than the other. The rapid adoption of less expensive computers in high schools leaves no doubt that price is an important consideration.

Figure 1. Survey Questionnaire

ID [ ][ ][ ][ ][ ][ ][ ] SURVEY OF COMPUTERS USED IN SCHOOLS

1) Do your students use computers as a part of their school activities, in or out of class? Yes__ No__

2) If yes, please give the following information on computers in use.

a) Computers in your school:

- Micro: Number and type: i)___;_____ ii)___;_____
  iii)___;_____ Total number___ Year first used_____
- Mini: Number and type: i)___;_____ ii)___;_____
  iii)___;_____ Total number___ Year first used_____

b) Computers located elsewhere:

- Micro: Number and type: i)___;_____ ii)___;_____
  iii)___;_____ Total number___ Year first used_____
  Mode of access: Terminal__; Courier__; RJE-card__; Visit___
- Mini: Number and type: i)___;_____ ii)___;_____
  iii)___;_____ Total number___ Year first used_____
  Mode of access: Terminal__; Courier__; RJE-card__; Visit___
- Macro: Number and type: i)___;_____ ii)___;_____
  iii)___;_____ Total number___ Year first used_____
  Mode of access: Terminal__; Courier__; RJE-card__; Visit___

Table 1. Response and Average Enrolment Rate by Region

Level	Region	Number of Schools	Average Enrolment	Percentage Return	Average Enrolment[c]
Secondary[a]	1. Central	384	976	69.5	999
	2. Eastern	101	904	74.3	968
	3. Midnorthern	39	722	71.8	693
	4. Northeastern	30	870	73.3	806
	5. Northwestern	25	630	64.3	614
	6. Western	105	905	66.6	955
	Total	684	923	70.0	947
Elementary[b]	1. Central	209	359	71.3	379
	2. Eastern	54	290	51.9	321
	3. Midnorthern	24	234	54.2	284
	4. Northeastern	20	269	75.0	291
	5. Northwestern	15	206	80.0	188
	6. Western	59	344	64.4	381
	Total	381	328	66.9	354

[a] All schools surveyed, including separate schools enrolling only grade 7 and higher.

[b] One in ten schools surveyed, including separate schools with grades K-6. The 66.9% response rate represents about 6.7% of all Ontario elementary schools.

[c] For schools returning questionnaires.

Table 2

Use of Computers by Level and Region

Region	Level			
	Elementary		Secondary	
	n in sample	% Using Computers	n in sample	% Using Computers
1. Central	149	8.7%	268	75.0%
2. Eastern	28	0.0	73	76.7
3. Midnorthern	13	0.0	28	67.6
4. Northeastern	15	0.0	22	63.6
5. Northwestern	12	0.0	18	44.4
6. Western	38	2.6	70	78.6
Total	255	5.5%	479	73.7%

Table 3

Use of Computers by Level and Enrolment

Enrolment	Level			
	Elementary		Secondary	
	n in sample	% Using Computers	n in sample	% Using Computers
Below 101	15	13.3%	8	25.0%
101 - 250	72	0.0	24	45.8
251 - 500	117	6.8	68	51.5
501 - 750	43	7.0	72	55.6
751 - 1,000	8	12.5	93	78.5
1,001 - 1,250			89	84.3
1,251 - 1,500			70	90.0
1,501 - 1,750			33	97.0
1,751 - 2,000			14	100.0
Above 2,000			8	100.0
Total	255	5.5%	479	73.7%

Table 4

Use of Computers by Secondary School Size
in Northwestern Ontario

Enrolment	n in sample	% Using Computers	Prov. Average
Below 101	-	-	25.0%
101 - 250	4	50.0%	45.8
251 - 500	7	28.6	51.5
501 - 750	1	0.0	55.6
751 - 1,000	1	100.0	78.5
1,001 - 1,250	5	60.0	84.3
Total	18	44.4%	67.6%

Table 5

Percentage and Number of Secondary Schools with Different Types of Computers by Region

(n = 479)

Region	Number and Percent	Type of Computers			
		Micro	Mini	Remote Mini	Macro
1. Central	%	40.7	26.1	5.6	36.5
	n	109	70	15	98
2. Eastern	%	37.0	41.1	5.5	34.2
	n	27	30	4	25
3. Midnorthern	%	57.1	10.7	0.0	25.0
	n	15	3	0	7
4. Northeastern	%	59.1	4.5	0.0	9.1
	n	13	1	0	2
5. Northwestern	%	44.4	0.0	0.0	0.0
	n	8	0	0	0
6. Western	%	41.4	15.7	24.3	28.6
	n	29	11	17	20
Total	%	42.2	24.0	7.5	31.7
	n	202	115	36	152

Table 6

Percentage and Number of Secondary Schools with Different Types of Computers by Enrolment

(n = 479)

Region	Number and Percent	Type of Computer			
		Micro	Mini	Remote Mini	Macro
Below 101	%	25.0	0.0	0.0	12.5
	n	2	0	0	1
101 - 250	%	37.5	0.0	4.2	4.2
	n	9	0	1	1
251 - 500	%	39.7	4.4	2.9	13.2
	n	27	3	2	9
501 - 750	%	31.9	18.1	8.3	13.9
	n	23	13	6	10
751 - 1,000	%	47.3	19.4	5.4	43.0
	n	44	18	5	40
1,001 - 1,250	%	46.1	31.5	6.7	41.6
	n	41	28	6	37
1,251 - 1,500	%	47.1	41.4	11.4	35.7
	n	33	29	8	25
1,501 - 1,750	%	42.4	45.5	15.2	51.5
	n	14	15	5	17
1,751 - 2,000	%	50.0	28.6	14.3	64.3
	n	7	4	2	9
Over 2,000	%	25.0	62.5	12.5	37.5
	n	2	5	1	3
Total	%	42.2	24.0	7.5	31.7
	n	202	115	36	152

Table 7

Numbers and Percentage of Ontario Secondary Schools with Different Types of Micro-Computers in June 1980

Name of Computer	Number and Percent of Schools	Number of Computers in Schools[a]								
		0	1	2	3	4	5	6	7-12	13-25
PET	%	72.0	10.2	4.0	6.1	2.3	1.0	2.9	1.2	0.2
	n	345	49	19	29	11	5	14	6	1
TRS80	%	88.7	5.4	2.7	0.8	0.6	0.8	0.6	0.0	0.2
	n	425	26	13	4	3	4	3	0	1
APPLE	%	97.5	1.7	0.2	0.2	0.0	0.2	0.0	0.2	0.0
	n	467	8	1	1	0	1	0	1	0
OHIOSCI	%	99.4	0.2	0.2	0.0	0.2	0.0	0.0	0.0	0.0
	n	476	1	1	0	1	0	0	0	0
SOL	%	99.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	n	477	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	%	96.2	3.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0
	n	461	16	1	1	0	0	0	0	0
TOTAL MICROS	%	57.8	16.3	7.5	6.3	4.0	2.3	3.8	1.7	0.4
	n	277	78	36	30	19	11	18	8	2

[a] Seven schools reported access to micro computers located elsewhere, including four with access to PETS.

Table 8

Number and Percentage of Ontario Secondary Schools with Different Types of Mini-Computers

(n = 479)

Number and Percent	Model of Computer							
	PDP11	IBM1130	WANG	PDP8	HP2100	IBM1530	OTHER	TOTAL[a]
%	6.7	6.1	5.0	1.3	0.6	0.4	4.8	24.2
n	32	29	24	6	3	2	23	116

[a] Three schools reported having two mini-computers.

Table 9

Numbers and Percentages of Ontario Secondary Schools with Remote Access to Mini-Computers in June 1980

(n = 479)

Number and Percent	Type of Computer							
	PDP11	IBM1130	WANG	PDP8	HP2100	IBM1130	OTHER	TOTAL[a]
%	0.6	4.4	1.7	-	-	-	2.3	8.1
n	3	21	8				11	39

a One school reported having remote access to two minicomputers, and one with remote access to four minicomputers.

Table 10

Mode of Access to Remote Mini-Computers

(n = 479)

Number and Percent	Mode of Access			
	Terminal	Courier	RJE	Visit
%	0.6	9.0	1.0	2.1
n	3	43	5	10

Table 11

Numbers and Percentages of Ontario Secondary Schools Using Different Types of Macro-Computers

(n = 479)

Number and Percent	Model of Computer					
	IBM370	IBM360	ICL	GEAC	OTHER/ UNKNOWN	TOTAL[a]
%	15.4	2.9	0.8	0.6	13.1	31.7
n	74	14	4	3	63	152

[a] Ten schools reported access to two macro computers, and two schools access to three macros, several did not indicate the model of the computer.

Table 12

Mode of Access to Remote Macro-Computers

(n = 479)

Number and Percent	Mode of Access			
	Terminal	Courier	RJE	Visit
%	6.3	25.9	5.8	4.2
n	30	124	28	29

Table 13

Percent and Number of Secondary Schools
with Different Combinations of
Computer Types by Region

Combination	Number & Percent	Region						
		Central	Eastern	Midnorthern	Northeastern	Northwestern	Western	Total
Micro	%	16.8	8.2	39.3	50.0	44.4	28.6	21.1
	n	45	6	11	11	8	20	101
Mini	%	10.8	21.9	0.0	0.0	0.0	8.6	10.6
	n	29	16	0	0	0	6	51
Macro	%	12.3	11.0	10.7	4.5	0.0	15.7	11.7
	n	33	8	3	1	0	11	56
Micro & Mini	%	6.3	11.0	3.6	4.5	0.0	2.9	6.1
	n	17	8	1	1	0	2	29
Micro & Macro	%	15.3	15.1	7.1	4.5	0.0	8.6	12.7
	n	41	11	2	1	0	6	61
Mini & Macro	%	6.7	5.5	0.0	0.0	0.0	2.9	5.0
	n	18	4	0	0	0	2	24
Micro & Mini & Macro	%	2.2	2.7	7.1	0.0	0.0	1.4	2.3
	n	6	2	2	0	0	1	11
No Computer	%	29.5	24.7	32.1	36.4	55.6	31.4	30.5
	n	79	18	9	8	10	22	146
Total	%	99.9	100.1	99.9	99.9	100.0	100.1	100.0
	n	268	73	28	22	18	70	479

Table 14

Percent and Number of Secondary Schools with Different Combinations of Computer Types by Enrolment

(n = 479)

Combination	Number & Percent	Enrolment				
		Below 501	501-1,000	1,001-1,500	Over 1,500	Total
Micro	%	31.0	20.0	19.5	10.9	21.1
	n	31	33	31	6	101
Mini	%	2.0	7.2	15.7	21.8	10.6
	n	2	12	25	12	51
Macro	%	5.0	12.7	12.6	18.2	11.7
	n	5	21	20	10	56
Micro & Mini	%	1.0	6.6	8.2	7.2	6.1
	n	1	11	13	4	29
Micro & Macro	%	6.0	12.7	14.5	20.0	12.7
	n	6	21	23	11	61
Mini & Macro	%	0.0	3.6	7.5	10.9	5.0
	n	0	6	12	6	24
Micro & Mini & Macro	%	0.0	1.2	4.4	3.6	2.3
	n	0	2	7	2	11
No Computer	%	55.0	35.8	17.6	7.2	30.5
	n	55	59	28	4	146
Total	%	100.0	99.8	100.0	99.8	100.0
	n	100	165	159	55	479

Table 15

Percent and Number of Secondary Schools with Different Combinations of Micro-Computer Models

(n = 479)

Combination	%	n
Pet	25.1	120
TRS80	9.2	44
Apple	1.3	6
Pet & TRS80	1.9	9
Pet & Apple	1.0	5
TRS80 & Apple	0.2	1
All three	0.0	0
Other computers	3.5	17
No computer	57.8	277
Total	100.0	479

Table 16

Number of Schools Adopting Different Types and Models of Computers by Year (n = 479)

	Micro			Mini				Macro		
Year	Pet	TRS80	Total[a]	PDP-11	IBM 1130	Wang	Total	IBM370	IBM360	Total[c]
1965					0		1	0		1
1966					1		1	0		0
1967					2		2	1		1
1968					0		1	2		3
1969					7		7	4		8
1970					0		2	9	1	17
1971					1		4	3	1	5
1972					1		3	4	2	10
1973					2	1	8	2	0	3
1974					0	1	5	0	0	4
1975				1	3	7	12	5	0	7
1976				2	1	3	10	2	0	2
1977	3		5	1	0	4	5	6	2	10
1978	8	10	15	5	0	4	9	4	2	13
1979	83	30	118	14	2	1	17	10	2	18
1980[b]	24	3	29	1	0	0	2	0	1	2
Total	118	43	167	24	20		89	52	11	104

a. Total may be smaller than the row total since one school may have purchased more than one computer.

b. Purchased planned for 1980-81 as of June '80.

c. Including "other" models.

Table 17

Estimates and Projections of Secondary School Adoptions of Macro-Computers

Year	Cycle 1 Actual	Cycle 1 Modeled	Cycle 2 Actual	Cycle 2 Projected
1965	1	0.56		
1966	0	1.13		
1967	1	2.21		
1968	3	4.10		
1969	8	6.84		
1970	17	9.65		
1971	5	10.83		
1972	10	9.41		
1973	3	6.54		
1974	4	3.86		
1975	7	2.07		
1976	2	1.05		
1977			10	9.34
1978			13	14.14
1979			18	17.40
1980				16.68
1981				12.58
1982				7.78
1983				4.37
1984				2.26
1985				1.13
1986				0.55

Table 18

Statistics and Standard Errors for
Estimates of Secondary School Adoptions
of Macro-Computers

Cycle	Statistics[a]					
	P	N_o	S_1	N	S_m	Y_m
I:						
Actual	-	-	1	61[b]	17	1971
Estimated	0.73	0.52	0.56	59.3	11.0	1972
S.E. (est.)	0.10	-	0.24	2.5	-	-
II:						
Actual	-	-	10	?	?	?
Estimated	0.73	11.0	9.34	86.8[b]	17.4	1980
S.E. (est.)	fixed	-	0.49	8.6	-	-

a

P = rate of adoption; S_1 = number of adoptions in year 1;
N = total number of adoptions; S_m = maximum number of adoptions;
Y_m = year of maximum adoptions.

b Sixty-one of 479 schools yields a 13% penetration; adding 87 additional schools would yield a 31% penetration.

Table 19

Estimates and Projections of Secondary School Adoptions of Mini-Computers

	IBM 1130		Wang		PDP 11		Total	
Year	Actual	Est.	Actual	Est.	Actual	Est.	Actual	Est.
1965	0						1	1.24
1966	1	1.54					1	1.54
1967	2	1.77					2	1.91
1968	0	1.94					1	2.35
1969	7	2.02					1	2.88
1970	0	1.89					2	3.51
1971	1	1.87					4	4.24
1972	1	1.67					3	5.07
1973	2	1.43	1	1.16			8	5.99
1974	0	1.18	1	2.32			5	6.99
1975	3	0.94	7	3.90	1	0.31	12	8.02
1976	1	0.74	3	4.93	2	0.89	10	9.04
1977	0	0.56	4	4.38	1	2.51	5	9.98
1978	0	0.42	4	2.84	5	6.35	9	10.76
1979	2[a]	0.32	1	1.48	14	12.56	17	11.33
1980				0.69		16.01		11.62
1981				0.30		11.98		11.60
1982						5.88		11.29
1983						2.29		10.70
1984						0.81		9.90
1985						0.28		8.95
1986								7.93
1987								6.90
1988								5.91
1989								4.99
1990								4.27

[a] Omitted from analysis.

Table 20

Statistics and Standard Errors for
Estimates of Secondary School
Adoptions of Mini-Computer

Model	Statistic					
	P	N_o	S_1	N	S_m	Y_m
IBM 1130						
Actual	-	-	1	18	7.0	1969
Estimated	0.33	5.62	1.54	19.3	2.0	1970
S.E. (est.)	0.11	-	0.38	1.6	-	-
WANG						
Actual	-	-	1	21	7	1975
Estimated	0.87	.91	1.16	22.2	4.9	1977
S.E. (est.)	0.21	-	0.42	1.9	-	-
PDP-11						
Actual	-	-	1	?	?	?
Estimated	1.09	0.16	0.31	60	16.0	1980
S.E. (est.)	0.14	-	0.14	fixed	-	-
Total						
Actual	-	-	1	?	17	?
Estimated	0.23	4.91	1.24	196.8	11.6	1981
S.E. (est.)	0.04	-	0.19	68.4	-	-

Table 21

Estimates and Projections of
Secondary School Adoptions of
Micro-Computers with
Statistics and Standard Errors

Year	PET		Total	
	Actual	Estimated	Actual	Estimated
1977	3	1.06	5	2.16
1978	8	10.34	15	18.43
1979	83	82.62	118	117.35
1930		202.69		237.04
1931		76.07		89.55
1932		9.28		12.80
1983		0.90		1.48
1984		0.09		0.17
1985		0.01		0.02

Model	Statistics						
	P	N_o	S_1	N	%	S_m	Y_m
PET							
Actual	-	-	3	?	-	?	?
Estimated	2.36	0.11	1.01	383	80%	225.8	1980
S.E. (est.)	0.19	-	0.35	fixed	fixed	-	-
TOTAL							
Actual	-	-	5	?	-	?	?
Estimated	2.19	0.27	2.16	479	100%	262.0	1980
S.E. (est.)	0.15	-	0.60	fixed	fixed	-	-